

## STRONGYLATE NEMATODES FROM MARSUPIALS IN NEW SOUTH WALES.

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(Sixty-six Text-figures.)

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The present communication is the fifth of a series dealing with the nematode parasites of Australian marsupials, the earlier papers giving accounts based largely on material from Queensland and Central Australia.

Twenty-five species are proposed as new and are distributed amongst eleven genera, three of which (*Cyclostrongylus*, *Parazoniolaimus*, and *Maplestonea*) are new.

Types of new species described in this report are deposited in the South Australian Museum, Adelaide.

This investigation has been made possible by the Commonwealth Research Grant to the University of Adelaide. We desire to acknowledge assistance in regard to material from Professor J. B. Cleland; Messrs. L. Gallard, Narara; A. S. Le Souef, Director, Sydney Zoological Gardens; and W. L. Rait, Adelaide. Much of the material was collected by the senior author between 1908 and 1911 during his residence in New South Wales. The locality quoted as Lower Hawkesbury is in the vicinity of Milson Island and the township of Hawkesbury River.

*List of Hosts and Parasites dealt with in this Paper.*

MACROPUS RUFUS Desm.: *Pharyngostrongylus alpha* J. & M.; *Zoniolaimus longispicularis* (Wood); *Cloacina magnipapillata*, n. sp.; *C. longispiculata* J. & M.

MACROPUS MAJOR Shaw: *Pharyngostrongylus alpha* J. & M.; *P. beta* J. & M.; *Zoniolaimus longispicularis* (Wood); *Zoniolaimus* sp.; *Cloacina obtusa*, n. sp.; *C. expansa*, n. sp.; *C. magnipapillata*, n. sp.; *Cyclostrongylus clelandi*, n. gen., n. sp.

MACROPUS ROBUSTUS Gould: *Pharyngostrongylus alpha* J. & M.

MACROPUS UALABATUS Less. & Garn.: *Pharyngostrongylus alpha* J. & M.; *P. beta* J. & M.; *P. epsilon* J. & M.; *Zoniolaimus ualabatus*, n. sp.; *Z. clelandi*, n. sp.; *Z. setifer* Cobb; *Z. brevicaudatus* Cobb; *Parazoniolaimus collaris*, n. gen., n. sp.; *Cloacina macropodis* J. & M.; *C. wallabiae*, n. sp.; *Cloacina* sp.; *Macropostrongylus dissimilis*, n. sp.; *Cyclostrongylus wallabiae*, n. gen., n. sp.; *Cyclostrongylus dissimilis*, n. gen., n. sp.; *Maplestonea typicum*, n. gen., n. sp.

MACROPUS RUFICOLLIS Desm.: *Pharyngostrongylus alpha* J. & M.; *P. beta* J. & M.; *P. delta* J. & M.; *P. epsilon* J. & M.; *P. zeta* J. & M.; *P. eta* J. & M.; *P. brevis* Canavan; *P. iota*, n. sp.; *P. macropodis* Y. & M.; *Macropostrongylus lesouefi*, n. sp.; *M. wallabiae*, n. sp.; *Zoniolaimus communis* J. & M.; *Z. onychogale* J. & M.; *Zoniolaimus* sp.; *Buccostrongylus australis* J. & M.; *Buccostrongylus setifer*, n. sp.; *B. labiatus*, n. sp.; *Cyclostrongylus gallardi*, n. gen., n. sp.; *Austrostrongylus wallabiae*, n. sp.

MACROPUS PARMA Waterhouse: *Pharyngostrongylus epsilon* J. & M.; *P. parma*, n. sp.

MACROPUS THETIDIS LESSON: *Pharyngostromgylus alpha* J. & M.; *P. delta* J. & M.; *P. epsilon* J. & M.; *P. zeta* J. & M.; *P. theta*, n. sp.; *Zoniolaimus* sp.; *Cloacina bancroftorum* J. & M.; *C. similis* J. & M.; *C. thetidis*, n. sp.; *Cloacina* sp.; *Buccostromgylus buccalis* J. & M.; *Globocephaloides thetidis*, n. sp.; *Hypodontus thetidis*, n. sp.

TRICHOSURUS CANINUS Ogilby: *Asymmetricongylus trichosuri*, n. sp.

#### PHARYNGOSTROMGYLUS Yorke & Maplestone.

The original species, *P. macropodis*, was described by Yorke and Maplestone in 1926. Mönnig in the same year described *australis*, attributing it to a preoccupied genus *Spirostromgylus*, but transferred it in 1927 to *Rugopharynx* which was shown by Wood (1929) to be a synonym of *Pharyngostromgylus*. This latter author described *P. woodwardi* in 1930. Canavan in 1931 added *P. brevis*. We described two others in 1938 and recently added four more (1939). In the present report three others are described and host records relating to nine of the known species are mentioned.

#### PHARYNGOSTROMGYLUS THETA, n. sp. Figs. 1-2.

From stomach, *Macropus thetidis*, New England.

Male 4.8; female 4.5 mm. Head with six small papillae; buccal cavity  $9\mu$  long; followed by transversely striated chitinized vestibule 0.04 mm. long,  $8\mu$  internal and  $14\mu$  external diameter, with wall becoming narrowed suddenly just before joining oesophagus. Oesophagus 0.56 mm. long, anterior part 0.37 mm., followed by a narrower portion around beginning of which is nerve ring, posterior region widening into bulb before joining intestine. Cervical papillae not observed. Excretory pore at level of nerve ring.

*Male*: Bursa with ventral lobes very small and separated from each other as well as from lateral lobes; lateral and dorsal lobes continuous, dorsal longer. Ventral rays parallel, cleft nearly to base; not reaching edge of bursa; externo-lateral shorter than, and slightly divergent from, laterals; laterals reaching edge of bursa, cleft three-quarters of their length; externo-dorsal long, thin, arising from same root as laterals, diverging from them, not reaching edge of bursa; externo-lateral, laterals and externo-dorsal each elevate bursa into slight papilla at their termination. Dorsal ray long, bifurcating just before its mid-length, each of the two slender branches reaching bursal edge and giving off a very short lateral ray at about mid-length. Spicules 1.9 mm. long, half of body length, stout, with striated alae extending nearly to tips. Gubernaculum present,  $40\mu$  long; with a pair of less chitinized leaf-like alae extending alongside the spicules.

*Female*: Body tapering suddenly behind vulva and again behind anus; tail pointed, 0.2 mm. long, ventrally directed; vagina muscular, 0.35 mm. long; vulva 0.13 mm. in front of anus; ripe eggs not seen.

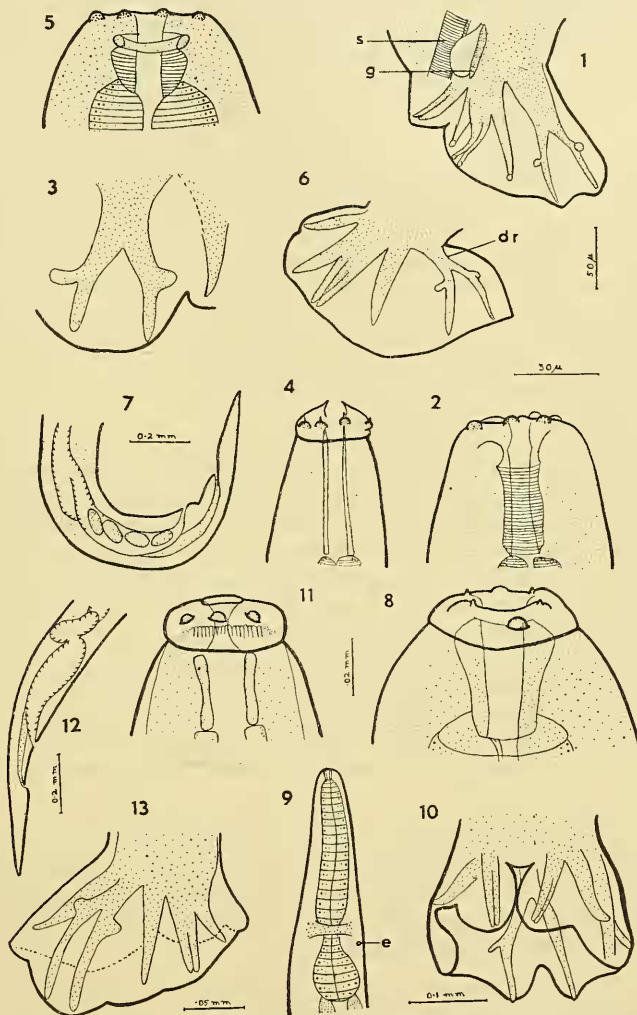
The species differs from *P. australis* in its shorter length, the form of the vestibule, length of the externo-dorsal ray, width of the dorsal ray, absence of median dorsal thickening of the bursa, relatively longer spicules, and the absence of papillae on the bursa. It differs from *P. brevis* in its shorter length, absence of leaf crown and cervical papillae, relatively shorter spicules, and in the relatively larger narrower vestibule. It can be distinguished from *P. alpha* and *P. beta* by the different dorsal ray, the form of the bursa (which is not deeply subdivided), and the absence of bursal papillae.

#### PHARYNGOSTROMGYLUS IOTA, n. sp. Figs. 3-4.

From *Macropus ruficollis*, Ourimbah, Gosford district (L. Gallard).

About 9 mm. long. Head with external leaf-crown similar to that of *P. gamma*, *P. macropodis*, and *P. eta*; with six similar papillae. Vestibule 1 mm. long, 0.2 mm. wide; without striations. Posterior end of very narrow oesophagus obscured by granular material, hence length not determined.

*Male*: Spicules 2.9 mm. long, one-third of body length. Bursa deeply lobed, papillated. Ventral rays cleft, not quite reaching edge of bursa; extero-lateral divergent from laterals near tip and shorter than laterals; laterals extending nearly



Figs. 1-2, *Pharyngostrongylus theta*. 1. bursa of male; 2. head.

Figs. 3-4, *P. iota*. 3. dorsal ray of bursa; 4. anterior end.

Figs. 5-7, *P. parva*. 5. head; 6. bursa; 7. posterior end of female.

Figs. 2 and 5 to same scale; figs. 1, 3, 4, and 6.

Figs. 8-10, *Cyclostrongylus wallabiae*. 8. head; 9. anterior end; 10. bursa.

Figs. 11-13, *C. gallardi*. 11. head, lateral view; 12. posterior end of female; 13. bursa.

Figs. 8 and 11 to same scale; figs. 9 and 12.

to edge; externo-dorsal stout, arising separately, not reaching bursal edge. Dorsal ray bifurcating at half-length and its branches not quite reaching edge, each branch giving off a short lateral ray at about mid-length.

*Female*: Vagina exceedingly long (1.4 mm.), wide, with very small eggs (0.07 mm. by 0.04 mm.); vulva 0.85 mm. and anus 0.63 mm. from tip of tail; tail long, tapering.

This form is very like *P. macropodis*, *P. gamma* and *P. eta*, differing from them in the absence of striations on the vestibule and in general measurements. It most closely resembles *P. gamma*, differing in having a relatively narrower vestibule, a much longer vagina and a stouter dorsal ray whose lateral rays are more robust and relatively shorter, and whose terminal branches are longer.

#### PHARYNGOSTRONGYLUS PARMA, n. sp. Figs. 5-7.

From oesophagus, *Macropus parma*, Narara, Gosford district (L. Gallard).

Filiform worms, tightly rolled; male 7.3 mm. long; females 6.7-7.5 mm. Body ending abruptly at anterior end and surmounted by six small papillae. Mouth opening  $10\mu$  in diameter; continuous with, and of same width as, buccal cavity ( $14\mu$  deep) and vestibule. Posterior part of buccal cavity surrounded by thick chitinous ring about  $4\mu$  long; followed by vestibule  $15\mu$  long, and with stout chitinous walls  $9\mu$  thick at anterior end, narrowing posteriorly and marked with radial striations. Oesophagus 0.54 mm. long, of uniform width until suddenly constricted near its posterior end and then widening into a terminal elongated bulb; nerve ring surrounding it at level of constriction, 0.4 mm. from anterior end; excretory pore near base of oesophagus.

*Male*: Bursa large, lobes not divided from one another. Owing to the closeness of the helix it is very difficult to roll the bursa into a position allowing the dorsal ray to be seen in dorsal view. Ventral rays reaching edge of bursa; externo-lateral ray stout, tapering at tip, not reaching edge; laterals cleft for half their length, reaching edge of bursa; externo-dorsal arising separately, stout, tapering, shorter than externo-lateral. Dorsal ray dividing near its base into two long narrow branches reaching nearly to edge of bursa and each giving off near its origin a short stout lateral branch. Spicules 0.96 mm. long, 1:7.6 of body length; narrow, with striated alae; tips curved, bluntly pointed.

*Female*: Posterior end tapering; tail bluntly pointed, 0.3 mm. long; vulva 0.15 mm. in front of anus; vagina fairly long, wide. Eggs in vagina  $0.1 \times 0.04$  mm.

This species differs from other members of the genus *Pharyngostrongylus* chiefly in its attenuate form and coiled habit, and in the structure of the vestibule.

#### PHARYNGOSTRONGYLUS ALPHA Johnston & Mawson 1938.

This parasite has been identified amongst collections taken from the following hosts: *Macropus rufus*, from Wentworth (coll. W. L. Rait); *M. major*, Coonamble; *M. ualabatus*, Lower Hawkesbury (coll. J. B. Cleland); *M. ruficollis*, Bathurst district; *M. thetidis*, New England; and *M. robustus* (*robustus*), N.S.W. (coll. A. S. Le Souef, Sydney Zoological Gardens).

#### PHARYNGOSTRONGYLUS BETA Johnston & Mawson 1938.

From *Macropus ualabatus*, Lower Hawkesbury (coll. J. B. Cleland); *M. ruficollis* from Bathurst district, Ourimbah (Gosford district), and Sydney Zoological Gardens; and *M. major*, Coonamble.

#### PHARYNGOSTRONGYLUS GAMMA Johnston & Mawson 1938.

From *Macropus ruficollis*, Bathurst district.



## PHARYNGOSTRONGYLUS DELTA Johnston &amp; Mawson 1938.

From *Macropus ruficollis*, Bathurst district, and from Sydney Zoological Gardens; *M. major*, Narrabri; and *M. thetidis*, New England.

## PHARYNGOSTRONGYLUS EPSILON Johnston &amp; Mawson 1938.

From *Macropus ualabatus*, Lower Hawkesbury River; *M. parma*, Gosford district; *M. thetidis*, New England; and *M. ruficollis*, Bathurst district.

## PHARYNGOSTRONGYLUS ZETA Johnston &amp; Mawson 1938.

From *Macropus ruficollis*, Bathurst district; and *M. thetidis*, New England.

## PHARYNGOSTRONGYLUS ETA Johnston &amp; Mawson 1938.

From *Macropus ruficollis*, Bathurst district.

## PHARYNGOSTRONGYLUS BREVIS Canavan 1931.

From *Macropus ruficollis*, Bathurst district; and *M. ualabatus*, Lower Hawkesbury district.

## PHARYNGOSTRONGYLUS MACROPODIS Yorke &amp; Maplestone 1926.

Specimens, probably belonging to this species, were taken from *Macropus ruficollis* from Bathurst district.

## CYCLOSTRONGYLUS, n. gen.

Trichoneminae; with long buccal capsule, thick cuticular collar around mouth, the inner surface of which is marked with parallel longitudinal striations extending into the buccal cavity and resembling at first sight a leaf crown of many narrow elements; arising from this collar are four submedian and two lateral papillae. Oesophagus varies in form in different species. Main stem of dorsal ray soon bifurcates, each branch giving off a short lateral ray. Posterior end of female resembles that in *Cloacina*. From stomach of marsupials. Type, *C. wallabiae*, n. sp., from *Macropus ualabatus*.

The generic name is applied because of the circumoral cuticular ring or collar. The genus differs from *Coronostrongylus* in the absence of a leaf crown; and from *Pharyngoststrongylus* in the shape of the bursa and in the absence of a vestibule. We have assigned to this genus, in addition to the type, two species *C. clelandi* and *C. gallardi*. A fourth species, *C. dissimilis*, has been placed here provisionally, but it probably belongs elsewhere, its state of preservation preventing us from giving a sufficiently detailed account of it.

## CYCLOSTRONGYLUS WALLABIAE, n. sp. Figs. 8-10.

From *Macropus ualabatus*, Lower Hawkesbury (coll. J. B. Cleland).

Worms of moderate size; male 8.5 mm. long; female 5.1 mm.; somewhat coiled. Anterior end rounded, surmounted by wide thick mouth-collar, bearing four small submedian papillae and a pair of small rounded laterals. Mouth opening round, large, leading into a long cylindrical buccal chamber 0.04 mm. long, 0.15 mm. internal diameter, with the walls about  $7\mu$  thick anteriorly but diminishing posteriorly; walls marked with transverse striations. At base of buccal cavity a rather disc-like wider ring of chitin lying against anterior end of oesophagus. Latter 0.07 mm. long in male, 1:11 of body length; wider than buccal capsule; and consisting of two parts—the anterior portion longer and narrowing suddenly at level of nerve ring, 0.55 mm. from head end of worm; the posterior part widening to form a bulb. Excretory pore at 0.56 mm., just behind nerve ring; cervical papillae not seen.

*Male*: Spicules short; 0.7 mm. long, 1:12 of body length; with very narrow striated alae. Gubernaculum not observed. Ventral lobes of bursa short, separate from one another; dorsal lobe with wide median cleft. Ventral rays long, cleft nearly to base: externo-lateral, short, lifting wall of bursa; laterals cleft nearly to base, reaching edge of bursa; externo-dorsal arising separately, nearly reaching bursal edge. Dorsal ray long, bifurcating soon after origin; each branch tapering and forming projection on edge of dorsal lobe, and giving off short lateral ray at about mid-length.

*Female*: The only available specimen is rather unsatisfactory. Body tapering suddenly behind region of vagina to end in long bluntly-pointed tail. Uteri parallel; vagina short; vulva at 0.25 mm., and anus at 0.2 mm. from tip of tail. Egg in vagina  $0.041 \times 0.025$  mm.

CYCLOSTRONGYLUS GALLARDI, n. sp. Figs. 11-13.

From *Macropus ruficollis*, Ourimbah, Gosford district (L. Gallard).

Male 4-5 mm. long; female 5-6 mm. Head with characteristic cuticular collar round anterior end, through which the hypodermis projects in six small rounded papillae. Mouth small, circular,  $10\mu$  diameter, leading to narrow buccal cavity,  $17\mu$  long, followed by wide buccal capsule  $30\mu$  long,  $12\mu$  wide internally,  $19\mu$  wide externally. Striations of hypodermis (resembling a leaf crown)  $7\mu$  deep and not reaching top of buccal cavity. Oesophagus 0.53 mm. long, 1:8-11 of body length; longer anterior region of uniform width, becoming constricted suddenly, then widening into large spherical bulb before joining intestine. Nerve ring around oesophageal constriction, 0.48 mm. from anterior end of worm; excretory pore just in front of nerve ring; cervical papillae not observed.

*Male*: Spicules 1.9-2 mm., 1:2.4 of body length; slender; with wide striated alae and blunt tips. Gubernaculum small. Bursa large, ventral part shorter than dorsal; lobes all joined but marked off by shallow indentations. Ventral rays cleft nearly all their length, reaching bursal margin; externo-lateral divergent from laterals, extending nearly to edge; medio- and postero-lateral cleft for half their length, a little shorter than externo-lateral; externo-dorsal arising separately and not reaching edge of bursa. Dorsal ray bifurcating after about one-third to one-quarter its length, each branch almost immediately giving off a very short lateral ray before extending nearly to edge of dorsal lobe; these branches relatively long and parallel.

*Female*: Body tapering gradually to posterior end; tail bluntly pointed, straight, 0.3 mm. long. Vagina muscular, 0.4 mm. long; vulva 0.13 mm. in front of anus. Eggs in vagina  $0.08 \times 0.04$  mm.

This species differs from *C. wallabiae* in the different form of the buccal capsule, papillae and dorsal ray of the bursa; from *C. clelandi* in regard to the lips, bursal rays and the characters of the buccal capsule; and from *C. dissimilis* in the form of the oesophagus and the dorsal ray.

CYCLOSTRONGYLUS CLELANDI, n. sp. Figs. 14-15.

From *Macropus major*, Coonamble (coll. A. S. Le Souef).

Slender worms, 10-11 mm. long, widest in anterior third, with fine annulate cuticular striations. Head surrounded by large cuticular mouth collar through which project four short cylindrical submedian and two very short lateral papillae. Mouth large, circular; buccal cavity 0.065 mm. long, 0.05 mm. wide; with walls marked by numerous longitudinal lines, at first sight suggesting a leaf crown of numerous elements. Oesophageal region packed with granular material in all but one specimen examined; oesophagus 1.7 mm. long in female, 1:6 of body length;

narrow; with small posterior bulb. Nerve ring, cervical papillae and excretory pore not recognized.

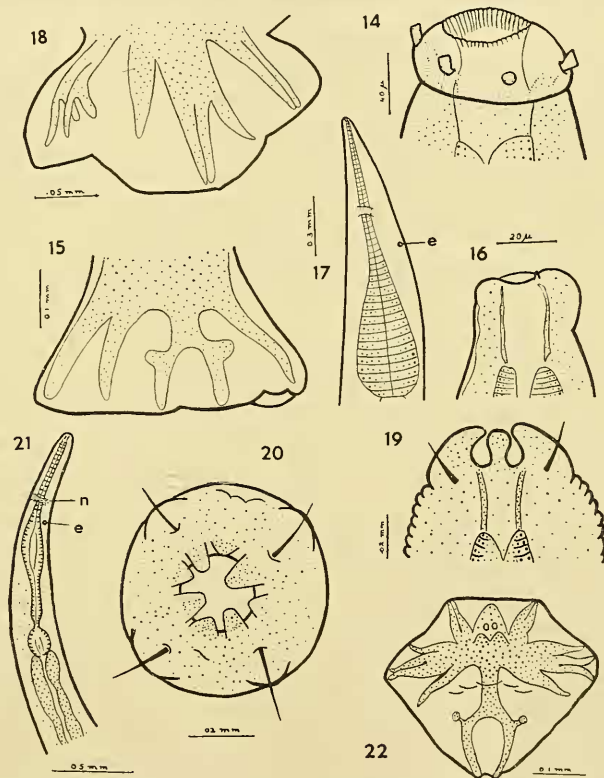
*Male*: Spicules 1.7 mm. long, 1:6 of body length, stout, with wide striated alae. Bursa large; ventral lobes joined, laterals separated from ventral and dorsal by shallow indentations. Ventral rays long, parallel; externo-lateral long, only slightly divergent from medio- and postero-laterals, all three of same length and nearly reaching edge of bursa; externo-dorsal arising separately, long, thin. Dorsal ray dividing before one-third length into two divergent branches, each giving off a very short lateral ray just before its middle. Genital cone short; accessory cone present.

*Female*: Body narrowing behind vulva to end in tapering pointed tail; vagina short; vulva at 6.8 mm., anus at 3.8 mm. from tip of tail. No eggs were seen in the only female found, which was immature, and about 11 mm. long.

*CYCLOSTRONGYLUS DISSIMILIS*, n. sp. Figs. 16-18.

From *Macropus ualabatus*, Milson Island, Lower Hawkesbury (J. B. Cleland).

Only one specimen, a damaged male, was found, but the unusual shape of the oesophagus warrants the inclusion of a description of the worm which was 13.9 mm.



Figs. 14-15, *Cyclostrongylus clelandi*. 14. head; 15. bursa.

Figs. 16-18, *C. dissimilis*. 16. head; 17. oesophageal region; 18. bursa.

Figs. 19-22, *Zoniolaimus setifer*, enlarged from Cobb (1898, fig. 30). 19. lateral view of head; 20. anterior view of head; 21. lateral view of anterior end; 22. posterior view of bursa.

in length. Head very indistinct, with cuticle so swollen that it appears asymmetrical. Only two short conical papillae observed. Mouth leads into a thin-walled cylindrical buccal capsule, 0.015 by 0.02 mm., opening into oesophagus. Latter 1 mm. long; 1:14 of body length; anterior half narrow and surrounded near its posterior end by nerve ring, posterior half increasing in diameter so that it has the form of a cone, with the base near the intestine. Excretory pore in vicinity of junction of the two oesophageal regions.

Spicules 2.5 mm. long, 1:5.6 of body length, with striated alae. Gubernaculum not seen. Bursa large; lobes well marked, distinct from one another. Ventral ray long, thin, nearly reaching bursal edge, cleft for entire length; externo-lateral arising with lateral but divergent from it after half length, and nearly reaching edge of bursa; lateral cleft for half length, nearly reaching edge; externo-dorsal short, stout, arising from base of laterals. Dorsal ray stout, short, bifurcating about half length, each branch dividing beyond mid-length into two rays, the inner being slightly longer and thinner.

As already stated, this species has been placed under the genus only provisionally, since the condition of the solitary specimen has prevented a more detailed account being given and a satisfactory assignment being made.

#### ZONIOLAIMUS Cobb 1898.

In a recent paper (1939) we rehabilitated Cobb's genus, giving a diagnosis and describing some new species. *Labiostrongylus* Yorke and Maplestone was placed as a synonym and the numerous species described under that genus were transferred to *Zoniolaimus*. Since the two species named by Cobb came from New South Wales material, an attempt has been made to interpret his formula and figures relating to them. In addition to describing two new species in this paper, we give host and locality records for three already known.

#### ZONIOLAIMUS SETIFER Cobb 1898. Figs. 19-22.

From the "brush wallaby", Moss Vale. We have already indicated that *Macropus ualabatus* is the species referred to. The following description is based on the figures and formula given by Cobb (1898, fig. 30).

Length of male, 7.75 mm. Head with eight lips, the four submedian larger than laterals, dorsal and ventral, and bearing each a long bristle (0.02 mm.) near the bases. Buccal capsule cylindrical, about 0.02 mm. wide, with base 0.04 mm. from top of lips. Oesophagus 1.23 mm. long, widening at about half its length into an elongate bulbous portion, then narrowing into a constricted region followed by a spherical bulb. Nerve ring at 0.4 mm. from head end and surrounding oesophagus at about two-thirds its length; excretory pore near beginning of median swollen portion of oesophagus, and about 0.52 mm. from anterior end of worm.

*Male*: Spicules thin, apparently 1.6 mm. long (i.e. 1:4.8 of body length). Bursa large, all rays except externo-dorsal reaching edge. Ventrals parallel, cleft half their length; externo-laterals arising with laterals, diverging from them near tip; laterals cleft half their length; externo-dorsal thin, arising from base of laterals but divergent from them. Dorsal ray bifurcating between one-third and one-half its length, each branch giving off short lateral ray soon after its origin. Genital cone present; accessory cone of two small bodies. The breadth of body of the male at base of buccal capsule, 0.069 mm.; at nerve ring, 0.13 mm.; at posterior end of oesophagus, 0.22 mm.; maximum width 0.28 mm.; width near bursa, 0.08 mm.



No particulars are given of the female, except a drawing of the anterior end.

The measurements given for the *Z. setifer* (*setiferus* in Cobb) agree with the sizes indicated in the diagrams. This worm then is much smaller than most species of the genus. We have not been able to identify it amongst our material.

*ZONIOLAIMUS BREVICAUDATUS* Cobb 1898.

Host not mentioned, but presumably from a "brush wallaby" (i.e. *Macropus ualabatus*) from Moss Vale, where Cobb was for a time engaged in official parasitological work.

The only information relating to this species is embodied in two figures, one of the female genitalia and one of male apparatus, together with the formula for a female worm. The diagrams are of little use in identification, as also are the measurements of the female. In no specimen of *Zoniolaimus* examined by us, however, are the spicules so short in relation to other parts of the male. They are apparently 1.5 mm. long. The measurements of a female, according to Cobb's formula, are: length of body 7.5 mm.; length of buccal capsule 0.06 mm.; anterior end to nerve ring 0.33 mm.; oesophagus 1.07 mm. (i.e. 1:7 of body length); vulva from tip of tail 0.38 mm.; anus from tip of tail 0.23 mm.; maximum width of body 0.32 mm. The figures in Cobb's paper (figs. 102 and 103) are said to be natural size; the length of the female is given as 7.5 mm., but the length of the sexual organs (as figured) is 30 mm. We suggest, therefore, that an error has occurred either in reduction of the original figures, or perhaps of a decimal place in the stated length of the worm. On the other hand, no such error has been detected in the case of *Z. setifer* (Cobb 1898, fig. 30), where the measurements given agree very well with the figures.

The spicules of *Z. brevicaudatus* as indicated in a diagram (which is stated to be natural size) are of the same length as those of *Z. setifer*, but a comparison of the figures given for the two species shows them to be much shorter than those of the latter in relation to other parts of the male system.

*ZONIOLAIMUS CLELANDI*, n. sp. Figs. 23-25.

From the stomach of *Macropus ualabatus*, Lower Hawkesbury (coll. J. B. Cleland).

Male 21 mm.; female 30 mm. long. Lateral lips very prominent, with a median terminal papilla; submedian lips rounded, each with a long seta. Buccal capsule 0.1 mm. wide, 0.07 mm. long; base 0.15 mm. from tip of submedian lips. Oesophagus 4 mm. long; 1:5 of body length.

*Male*: Dorsal lobe of bursa long. Dorsal ray long, giving off a fairly long branch on each side, the main stem continuing for a distance somewhat greater than the length of each branch, and then bifurcating into two rather broad terminal rays reaching the edge of the bursa. Spicules 7.2 mm., 1:3 of body length.

*Female*: Tail long, tapering; vulva at 1.7 and anus at 0.9 mm. from tip of tail; vagina narrow, twisted, 1.5 mm. long; eggs (in vagina) 0.12 by 0.07 mm.

The species resembles *Z. longispicularis* and *Z. communis*. It differs from the former in the form of the lateral and submedian lips and in the presence of setae on the lips, the thinner dorsal ray and the different form and position of the branches of that ray. It differs from *Z. communis* in the form of the dorsal ray, relative sizes of the lateral and submedian lips, length of setae on the lips, and in the rather shorter spicules.

*ZONIOLAIMUS UALABATUS*, n. sp. Fig. 26.

From stomach, *Macropus ualabatus*, Lower Hawkesbury (coll. J. B. Cleland).

Only immature females found; short, stout; 6.4–7 mm. long; 0.3 mm. maximum breadth; body with fine longitudinal striations. Head differs from that of any other known member of the genus in having the four submedian lips smaller than the laterals. Submedians conical, each with short seta; laterals tall, wider distally where they bear each a small median rounded papilla; a dorsal and a ventral lip present, conical, as large as lateral lips. Buccal capsule 0.045 mm. wide; 0.051 long from top of lips. Oesophagus 1.1–1.4 mm. long; 1:6–7 of body length; base surrounded by a pair of sheath-like prolongations of intestinal wall. Nerve cord at 0.35–0.4 mm. from head end; excretory pore just behind nerve ring; cervical papillae not observed.

Body narrows suddenly behind vulva, and again behind anus to end in narrow pointed tail, 0.3 mm. long. Anus 0.17 mm. behind vulva. Since the above account was written two adult females, 20 mm. long, were found amongst the material from the same host, the organs in these worms presenting the same proportions as in the younger specimens.

*ZONIOLAIMUS LONGISPICULARIS* (Wood 1929).

This large species, originally described as a *Labiostrongylus*, has been identified amongst material collected from *M. rufus*, Wentworth, South-Western New South Wales, and from Balranald; and *M. major*, from Narrandera and Narrabri.

*ZONIOLAIMUS COMMUNIS* Johnston & Mawson 1939.

From *Macropus ruficollis*, Bathurst district.

*ZONIOLAIMUS ONYCHOGALE* Johnston & Mawson 1939.

From *Macropus ruficollis*, Bathurst district.

*ZONIOLAIMUS* sp.

Immature specimens and females, not identifiable specifically, were found in *Macropus thetidis*, New England; *M. major*, Coonamble; *M. ualabatus*, Lower Hawkesbury; and *M. ruficollis*, Ourimbah, Gosford district.

*PARAZONIOLAIMUS*, n. gen.

Trichoneminae: Lips prominent, laterals largest, dorsal and ventral smallest. Short cuticular projecting frill around head region just behind lips, followed by slight constriction. Bursa large; ventral lobes separate; dorsal ray giving off a pair of lateral branches and then bifurcating. Female with tapering pointed tail; vulva a short distance in front of anus. From stomach of marsupials. Type, *P. collaris*, n. sp., from *Macropus ualabatus*.

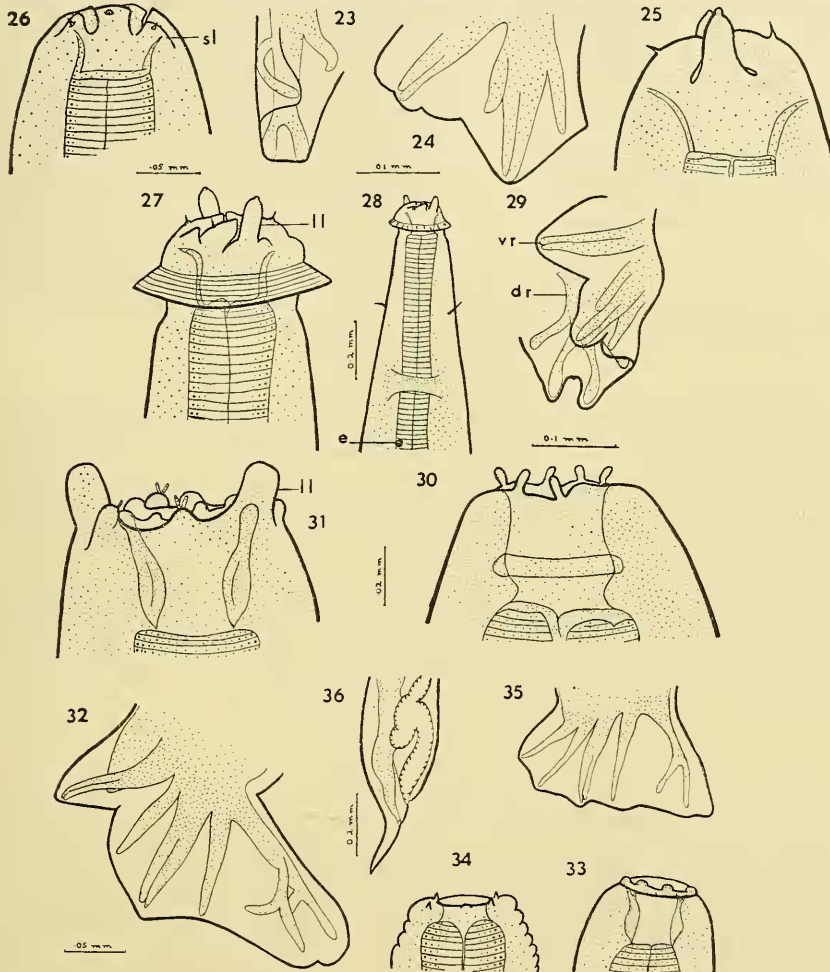
This genus is close to *Zoniolaimus* from which it differs in the possession of a cuticular frill surrounding the head.

*PARAZONIOLAIMUS COLLARIS*, n. sp. Figs. 27–29.

From stomach, *Macropus ualabatus*, Lower Hawkesbury (J. B. Cleland).

Body long, stout; male 15–16.5 mm. long; adult female 20–30 mm.; young females (devoid of eggs) from 11 mm. long. Anterior end with eight lips; two laterals, long, upright, each with small round terminal papilla; four submedian shorter, stout, bent inwards, each bearing rounded papilla with upwardly-directed bristle, the tip of which divides into two; distal end of each submedian lip dividing into two short laterally-directed processes; ventral and dorsal lips short, conical. Behind origin of lips arises a cuticular frill, with free outer edge, 0.03 mm. wide, marked with circular concentric striations, parallel to its edge. Head in this region 0.18 mm. diameter, and followed by somewhat constricted neck region

widening after 0.06 mm. to form body proper. Buccal cavity 0.07 mm. in diameter; squarish in side view; lined by thick chitin; base 0.1 mm. from anterior end of submedian lips. Oesophagus about 1.4:2 (or less) of body length; widening towards its posterior end, to become surrounded by sheath-like granular prolongation of intestinal wall. Nerve ring surrounding oesophagus about 0.6 mm. from



Figs. 23-25, *Zoniolaimus clelandi*. 23. dorsal lobe of bursa; 24. ventral and lateral lobes of bursa; 25. head.

Fig. 26. *Z. ualabatus*, head.

Figs. 23, 24, and 25 to same scale.

Figs. 27-29, *Parazoniolaimus collaris*. 27. head; 28. anterior end; 29. half of bursa, ventral and lateral lobes folded over dorsal lobe. All figures to same scale.

Fig. 30, *Maplestonema typicum*, head.

Figs. 31-32, *Macropostrongylus lesouefi*. 31. head, sublatero view; 32. bursa.

Fig. 33, *M. wallabiae*, head.

Figs. 34-36, *M. dissimilis*. 34. head; 35. bursa; 36. posterior end of female.

Figs. 30, 31, and 34 to same scale; figs. 32, 33 and 35.

anterior end of body; cervical papillae long, threadlike, about half-way between nerve ring and frill; excretory pore about 0.2 mm. behind nerve ring.

*Male*: Bursa large, ventral lobes separate from one another, joined to lateral lobes; dorsal lobe prolonged with rather large median indentation. Ventral rays long, parallel, cleft nearly all their length. Externo-lateral ray short, about half length of laterals; externo-dorsal two-thirds length of laterals with which it arises. Laterals long, parallel, cleft nearly all their length. Dorsal ray very broad at base; giving off at about mid-length a pair of lateral club-shaped branches, and soon afterwards dividing into two club-shaped rays forming an arch reaching into prolongations of the dorsal lobe. Genital cone with small button-like structure on its tip. Spicules 4.05 mm. long in a male 16 mm. long, 1:4 of body length; with striated alae extending nearly all their length, widening near distal ends. Spicules difficult to trace in whole specimens, and have to be dissected out. Gubernaculum 0.08 mm. long, canoe-shaped.

*Female*: Body tapering to a pointed tail; intestine narrowing suddenly about 0.3 mm. from anus and surrounded by narrow band of tissue (glandular?) before passing to anus; latter 0.7 mm. from tip of tail. Vagina thin, long; vulva about 0.35 mm. in front of anus; eggs 0.09 mm. by 0.07 mm.

#### MAPLESTONEMA, n. gen.

Since males have not been found, we cannot give a complete diagnosis.

Trichoneminae. Anterior end rounded; no mouth collar; six equal elongate papillae around mouth; deep buccal cavity supported only by narrow ring of chitinous substance near its base; oesophagus of uniform width. Male unknown. Female with tail tapering to a point; vulva just in front of anus. From stomach of marsupials. Type *M. typicum*, n. sp., from *Macropus ualabatus*, Lower Hawkesbury.

This genus differs from its nearest relatives *Macropostrongylus* and *Cloacina* in the absence of a leaf crown, and in the possession of six equal oral papillae. It differs from *Buccostrongylus* in the structure of the buccal capsule; and from *Spirostrongylus* Y. & M. in the absence of the leaf crown and in the characters of the buccal capsule. The generic name is proposed in recognition of Dr. Maplestone's contributions to Australian helminthology.

#### MAPLESTONEMA TYPICUM, n. sp. Fig. 30.

From *Macropus ualabatus*, Lower Hawkesbury.

We have examined only two immature female specimens. They are small and coiled; about 6.1 mm. in length. Flattened anterior end with six short thin digitate papillae surrounding wide mouth; latter leading into large cavity, 40 $\mu$  long, 35 $\mu$  in diameter. This cavity, at about three-fourths length, is surrounded by ring of chitin 8 $\mu$  long, 5 $\mu$  thick. No leaf crown. Oesophagus 0.95 mm. long, rather wide, slightly enlarged towards posterior end; surrounded by nerve ring at about end of its anterior half (0.4 mm. from head); excretory pore just behind this level, 0.47 mm. from head end. Body tapering gradually at posterior end, tail pointed, tip curved dorsally. The vulva can just be distinguished, 0.25 mm. in front of the anus. The latter is equidistant from the vulva and the tip of the tail.

#### MACROPOSTRONGYLUS Yorke & Maplestone 1926.

This genus was based on *M. macropostrongylus* Y. & M. (type) and *M. australis* Y. & M. from *Macropus* sp. from North Queensland. Baylis (1927) added a third species, *M. yorkei*, from the same region. Wood in 1930 described *M. baylisi* from *Macropus robustus woodwardi*. *M. macropostrongylus* and *M. yorkei* were recorded



by us from Queensland wallabies (1939). We now add two new species from the red-necked wallaby and one from *M. ualabatus* in New South Wales.

MACROPOSTRONGYLUS LESOUEFI, n. sp. Figs. 31-32.

From stomach of *Macropus ruficollis*, Sydney Zoological Gardens.

Short worms tapering more towards anterior end. Male 6.2-8.4 mm.; female about 10.7 mm. Anterior end with two large prominent lateral papillae, and four small submedian papillae, the latter each with two short bristles. Buccal capsule about 0.04 mm. long and 0.02 mm. in diameter in male; wall not regularly chitinized but middle part (i.e. middle longitudinal layer) most strengthened; wall ending anteriorly in six (perhaps eight) rounded knobs, presumably corresponding to a leaf crown. Oesophagus about 0.95 mm. long (in male); comprising two parts, a longer anterior, about the middle of which is the nerve ring, and a shorter posterior portion, narrow at the beginning but widening to a bulb. Excretory pore not detected; cervical papillae long, hair-like, at 0.25 mm. from anterior end of worm.

*Male*: Spicules seem to vary in length in specimens otherwise identical, but they are always short, 0.36-0.7 mm.; stout; ends tapering, rounded; wide striated alae extending nearly to tip. Bursa large; dorsal lobe longest; ventral lobes short, joined ventrally. Ventral rays long, thin, cleft nearly all their length; laterals and externo-dorsals arising from same root, long, thin; medio- and postero-laterals longest, cleft half their length. Dorsal ray bifurcating after half its length, each branch giving off stout lateral ray from its mid-length. Genital cone very small.

*Female*: Uteri parallel; ovejectors 0.15 mm. long; vagina about 0.25 mm. long; vulva about 0.9 mm. and anus at 0.6 mm. from tip of tail.

This species closely resembles *M. macropostrongylus* but differs from it in the length of the spicules and oesophagus as well as in the shape of the female tail and in the characters of the head.

It is named for Mr. A. S. Le Souef, Director of the Sydney Zoological Gardens and author of important works dealing with Australian vertebrates.

MACROPOSTRONGYLUS WALLABIAE, n. sp. Fig. 33.

From stomach, *Macropus ruficollis*, Bathurst district.

Male 8.4 mm., female 11.4 mm. long; cuticle marked with fine striations. Anterior end blunt; mouth collar with six small rounded papillae. Buccal capsule 0.045 mm. deep and 0.025 mm. wide (internal measurement) except at anterior end where walls bend outwards; walls much thicker in posterior half than in anterior. Short leaf crown probably present, arising from anterior end of capsule but number and shape of elements indistinguishable. Oesophagus about 0.8 mm. long, with wider anterior part and short thin posterior part ending in bulb. Nerve ring appears to be around thinner part of oesophagus. Cervical papillae long, threadlike, at 0.25 mm. from anterior end of worm.

*Male*: Spicules short, about 0.8 mm. long, 1:10 of body length, with wide striated alae and bluntly rounded tips. Bursa large; ventral lobes small, not joined ventrally and almost separate from lateral lobes; dorsal lobe wide, long. Condition of specimen prevented disposition of bursal rays from being ascertained accurately. Ventral rays short, parallel, almost to edge of bursa; externo-lateral ray divergent from laterals for most of its length; laterals stout, cleft for half their length and reaching almost to bursa; externo-dorsal arising separately, long, stout, not reaching edge of bursa. Dorsal ray indistinct; two main branches

apparently reaching edge of dorsal lobe and each giving off a lateral ray at about mid-length. Genital cone short.

*Female*: Ovejectors long, thin; vagina short, wide; vulva 0.8 mm., and anus 0.3 mm. from tip of tail. Tail long, tapering, ending in point. Eggs 0.13 mm. by 0.07 mm.

This species closely resembles *Spirostrongylus spirostrongylus* Y. & M. 1926 in the arrangement of the buccal capsule, but those authors do not indicate the presence of oral papillae. It has been assigned to *Macropostrongylus* on account of the buccal capsule, leaf crown, shape of bursa, general arrangement of rays, and character of female tail; but it differs from other species of this genus in that the lateral and submedian oral papillae are of equal size.

MACROPOSTRONGYLUS DISSIMILIS, n. sp. Figs. 34-36.

From *Macropus ualabatus*, Lower Hawkesbury.

Rather plump worms; males 6.5 mm.; females, often coiled, 6.8 mm. long. Anterior end truncated, bearing four small conical submedian papillae and two very small laterals. Buccal capsule continuous from oral opening, 10 $\mu$  deep, 15 $\mu$  in diameter, with chitinized walls. Oesophagus widening gradually towards base; 0.55 mm. long. Nerve ring at 0.19, excretory pore at 0.46, and threadlike cervical papillae 0.1 mm. from anterior end of worm. Anterior part of intestine surrounded by granular lobes.

*Male*: Bursa large; lobes not deeply separated from one another; rays all thin and reaching nearly to edge of bursa; externo-lateral divergent from laterals; externo-dorsal arising separately; dorsal ray stouter, bifurcating after half its length, each branch immediately giving off a lateral ray almost as long as itself. Genital cone small, pointed. Spicules 0.7 mm. long, 1:9 of body length, with wide striated alae. Apparently two gubernacula, the larger of which is more anteriorly situated and may be a chitinization of the spicule sheath.

*Female*: Body tapering suddenly at vulva; tail pointed, backwardly directed. Ovejectors 0.3 mm. long; vagina 0.35 mm. long; vulva 0.29 mm. and anus 0.2 mm. from tip of tail. Eggs 80 $\mu$  by 50 $\mu$ .

This species is placed in the genus with some reserve because of the absence of a leaf crown and because the submedian papillae are larger than the laterals. It seems related to *M. yorkei* which it resembles in many features but differs in its much smaller size, in the shape of the buccal capsule, and in the absence of a leaf crown, which we have recognized in our specimens of *yorkei*, though Baylis regarded its presence as doubtful.

BUCCOSTRONGYLUS Johnston & Mawson 1939.

Although the general appearance of the head of two species now to be described, *Buccostrongylus setifer* and *labiatus*, does not at first sight suggest that they belong to the same genus, they have essentially similar structure, the chief difference being in the size of the oral papillae and lips. In these features they represent extremes of which the type species of the genus, *B. buccalis*, is the mean. There is also a difference in the formation of the leaf crown which in the type is formed by the indented anterior edge of the buccal capsule, but in *B. setifer* by an accessory projection inwardly from the anterior edge of the buccal capsule. In the latter species there is also a difference in the form of the dorsal ray, the lateral branches coming off before instead of after the bifurcation, but these variations are not considered sufficient to justify the erection of a new genus.

**BUCCOSTRONGYLUS BUCCALIS Johnston & Mawson 1939.**

This species has been found in *Macropus thetidis* from New England, the nematodes possessing lips slightly more prominent and the spicules a little longer than those described previously from Queensland material.

**BUCCOSTRONGYLUS AUSTRALIS Johnston & Mawson 1939.**

Specimens of this species were found in *Macropus ruficollis* from Bathurst district. Previously recorded from two other species of *Macropus* from Queensland.

**BUCCOSTRONGYLUS LABIATUS, n. sp. Figs. 37-38.**

From stomach of *Macropus ruficollis*, Bathurst district.

Worms slender, short, usually coiled. Male 3.7-4.3 mm.; female 5-6 mm. long. Cuticle marked with fine longitudinal striations. Cuticle of mouth collar raised into six rounded lips, outgrowths of the subcuticular tissue between these form six small rounded papillae; four submedian lips each with a bristle; two lateral lips without bristle. Cuticle around mouth further raised into 6-8 peri-oral lips, the ventrals being larger than the others.

Within the mouth is a long straight chitinized buccal capsule or vestibule. In all specimens this is very indistinct, only its outline and posterior limits being perceptible; its termination is 0.043 mm. from top of lips and about 0.01 mm. wide (external), but the anterior end is not clear. It is not striated. Oesophagus thin, 0.65-0.75 mm. long, 1:7.5 of body length, terminating in large distinct bulb. Nerve ring surrounding oesophagus at about half length; excretory pore just behind nerve ring; cervical papillae not observed. Intestine without processes around base of oesophagus.

*Male*: Spicules about 1 mm. long, 1:3.7-4.3 of body length; with very wide striated curved alae; distal ends of spicules lying together, each surmounted by a small disc of thin chitinous material. Gubernaculum probably present; genital cone short. Bursa wide, much shorter ventrally than dorsally; lobes not separated by deep indentations. Ventral rays parallel, nearly reaching edge of bursa and cleft nearly all their length. Externo-lateral and externo-dorsal shorter than laterals with which they arise, and lifting side wall of bursa; laterals reaching practically to edge of bursa, and cleft for half length. Dorsal ray long, bifurcating after one-quarter of its length, almost immediately afterwards each branch giving off a short lateral ray and then continuing nearly to edge of bursa, the two branches coming closer together near their distal ends.

*Female*: Body tapering rapidly but evenly from region of vagina to end in blunt point. Ovejectors about 0.5 mm. long, narrow; vagina about 0.3 mm. long; vulva 0.37 mm., and anus 0.3 mm. from tip of tail. Eggs in vagina about 0.09 mm. by 0.05 mm.

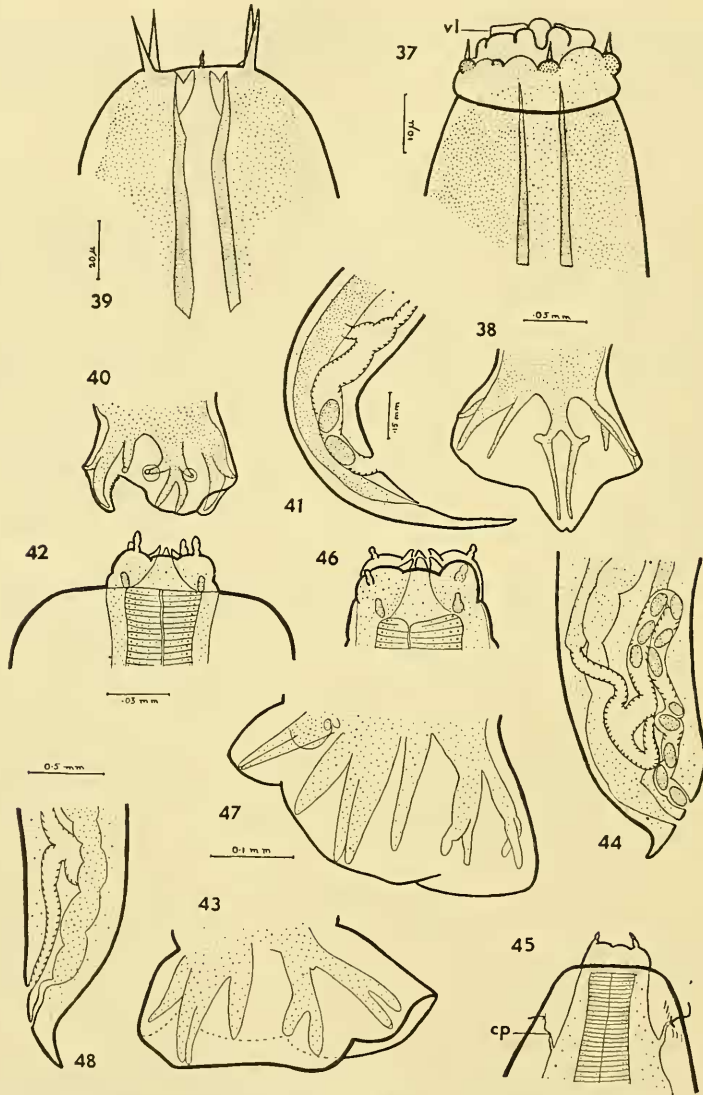
This species differs from *B. setifer* chiefly in regard to the lips and papillae.

**BUCCOSTRONGYLUS SETIFER, n. sp. Figs. 39-41.**

From stomach of *Macropus ruficollis*, Bathurst district.

Short worms, tapering to both ends, tending to be somewhat coiled. Cuticle with fine longitudinal striations. Male 4.8 mm.; female 6.5-7 mm. long. Mouth surrounded by six low rounded papillae, each with a tapering bristle, those in submedian positions being very long, and the two laterals short. The buccal capsule differs from that in other members of this genus in being much longer (0.075-0.085 mm.) and in enclosing a wider cavity near its anterior end, where the walls become narrowed to a fine rim around the mouth. This enlarged part is

0.015 mm. wide and about 0.02 mm. deep, while the succeeding portion is 0.01 mm. in internal diameter. It differs also in having a definite leaf crown of a few (4, perhaps 6) elements projecting from the wall of the anterior wide part of the capsule.



Figs. 37-38, *Buccostrongylus labiatus*. 37. head; 38. bursa.

Figs. 39-41, *B. setifer*. 39. head; 40. bursa; 41. posterior end of female.

Figs. 38 and 40 to same scale.

Figs. 42-45, *Cloacina expansa*. 42. head; 43. bursa; 44. posterior end of female; 45. anterior end.

Figs. 46-48, *C. obtusa*. 46. head; 47. bursa; 48. posterior end of female.

Figs. 42 and 46 to same scale; figs. 43, 45, and 47; figs. 44 and 48.



The anterior end differs from that of pharyngostrongyles in that there is no differentiation into buccal capsule and vestibule, the whole structure, referred to above as buccal capsule, being a continuous cylinder. There are also no striations on this structure. There is, as in other species of *Buccostrongylus*, a slight inflation of the cuticle around the anterior end.

Oesophagus 0.1 mm. long; with two parts, a long wide anterior and a shorter narrow posterior, the latter terminating in a slight bulb. Nerve cord not seen. Excretory pore near posterior end of anterior portion of oesophagus.

*Male*: Spicules stout, 1.3–1.4 mm. long, 1:4 of body length; with wide striated alae extending almost to the rounded tips. Bursa very closely resembling that of pharyngostrongyles in being small and covered with papillae on inner surface of ventral and lateral lobes. Lobes well separated from one another; dorsal widest and longest. Externo-lateral and externo-dorsal rays shorter than laterals with which they arise, projecting on wall of bursa. Dorsal ray with two lateral branches at about its mid-length, the main stem continuing a short distance before dividing into two rays reaching edge of bursa; lateral branches stout, entering into dorsally projecting pockets of bursal wall. Gubernaculum not observed.

*Female*: Body ending in tapering pointed tail, about 0.38 mm. long; distance from anus to vulva about 0.28 mm. Uteri long, straight; ovejectors narrow; vagina wide, quite long; eggs (in vagina) about 0.12 mm. by 0.06 mm.

This species differs from other members of the genus in the length of the buccal capsule, presence of a leaf crown, form of bursa, and shape of female tail.

#### CLOACINA Linstow 1898.

This imperfectly characterized genus was known only from the type species, *C. dahl*, from a wallaby in New Britain. In 1938 we recognized representatives amongst Australian material and, as a result, were able to give a diagnosis differentiating it from *Macropostrongylus* and to add fifteen new species from Central Australian kangaroos and wallabies. A study of material from Queensland has permitted recognition of five additional species (1939). We now describe five more new forms and record the occurrence of four known species from New South Wales Macropods.

#### CLOACINA EXPANSA, n. sp. Figs. 42–45.

From *Macropus major*, Coonamble (coll. A. S. Le Souef).

Male 9.6 mm.; female 15–18 mm.; cuticle widened at level of base of lips, inflated region thinning out to end near the level of the posterior end of the oesophagus; buccal capsule 0.05 mm. diameter, 0.01 mm. long. Oesophagus 0.55 mm. long; nerve cord at 0.3 mm., excretory pore at 1 mm. (i.e. about 0.35 mm. behind end of oesophagus), and cervical papillae at 0.12 mm. from head end.

*Male*: Bursa as in *C. longispiculata*; spicules 5.8 mm., 1:1.7 of body length.

*Female*: Anus at 0.3 mm., and vulva at 0.4 mm. from tip of tail; eggs 0.14 by 0.07 mm.

This species closely resembles *C. longispiculata* in general form, shape of bursa, oesophagus, submedian papillae; shape of posterior end of the female; and spicule:body-length ratio. It differs in the following features: slightly greater length; greater extension backwardly of the widened cuticular region at the head end; wider buccal capsule with thicker, shorter chitinous ring; absence of lateral papillae; cervical papillae nearer anterior end; and the longer, narrower vagina. The specific name is given because of the wide cuticular inflation anteriorly.

*CLOACINA OBTUSA*, n. sp. Figs. 46-48.

From *Macropus major*, Coonamble (coll. A. S. Le Souef).

Males 11.5-13 mm. long; females 18-22 mm.; not tapering markedly at anterior end which is truncate; six large lips, submedians with small two-jointed papillae. Buccal capsule 0.055 mm. wide; 0.015 mm. deep with base 0.04 mm. from top of lips. Leaf crown of six elements arising from base of capsule and bluntly pointed at distal ends. Oesophagus 0.75 mm. long, widening at base; surrounded by nerve ring about its middle. Excretory pore just in front of posterior end of oesophageal region; thus nerve ring is 0.36, and excretory pore 0.68 mm. from anterior end of worm.

*Male*: Bursa large, lobes not deeply separated. Ventral rays together, extending nearly to edge, cleft for most of their length; externo-lateral stout, tapering, almost reaching to edge; laterals extending nearly to edge, cleft for three-fourths of their length, tips separate; externo-dorsal arising separately, shorter than laterals. Dorsal ray stout, bifurcating after one-third length, each branch ending in two short processes, of which outer is shorter and stouter, neither reaching edge of bursa. Spicules about 3.5 mm. long, 1:3 of body length. Gubernaculum absent. Genital cone very short, rounded.

*Female*: Body tapering suddenly beyond vulva to end in pointed dorsally-directed tail, 0.27 mm. long. Vagina about 0.8 mm. long; vulva 0.2 mm. in front of anus; eggs in vagina 0.1 by 0.05 mm.

This species resembles *C. macropodis* in its head region but differs in its greater length; blunt elements of the leaf crown; longer buccal capsule; and in the spicule:body-length ratio. The specific name is given on account of the blunt tips of the elements of the leaf crown.

*CLOACINA MAGNIPAPILLATA*, n. sp. Figs. 49-52.

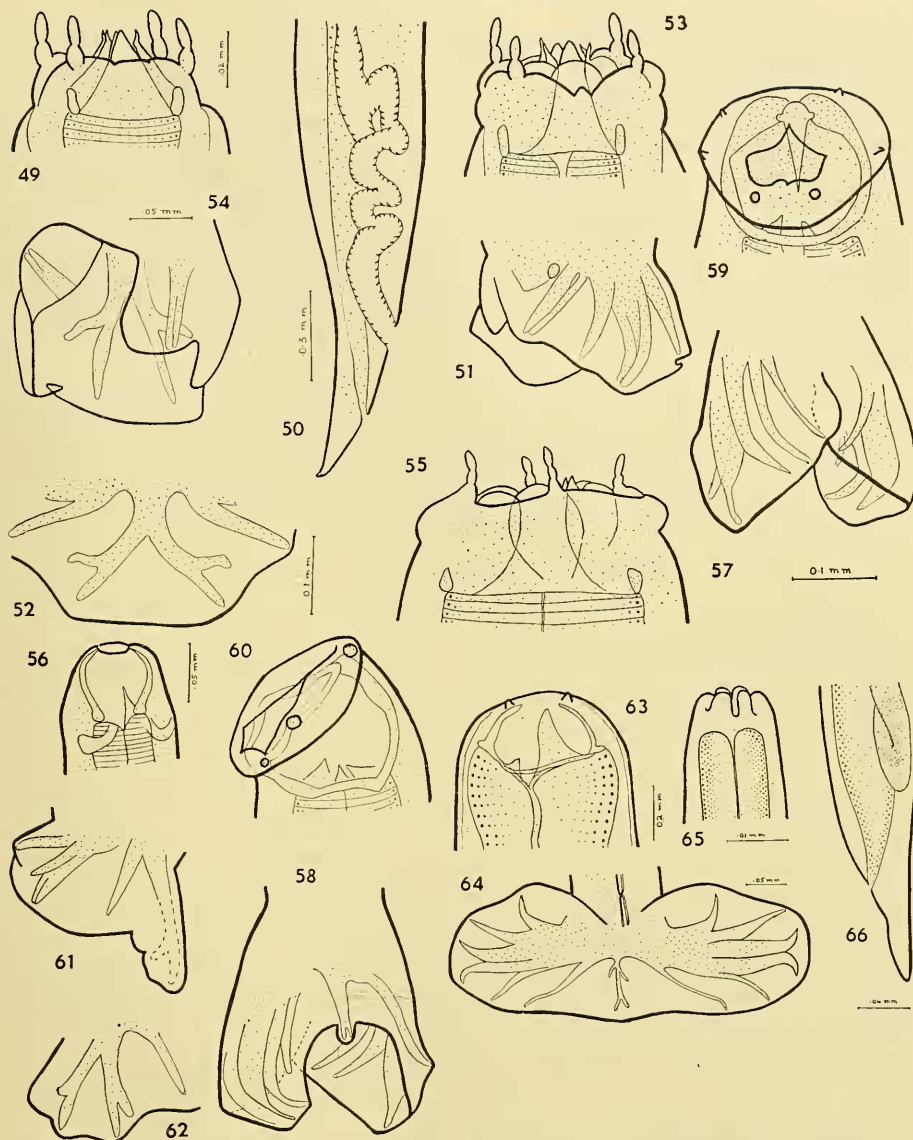
From *Macropus major* (type host), Coonamble (coll. A. S. Le Souef); and *M. rufus*, Wentworth (coll. A. L. Rait).

Male 10-11 mm.; female 12-15 mm. long; head with six low lips, submedians with long, two-jointed papillae, laterals each with small papilla; buccal capsule 0.032 mm. diameter, 0.01 mm. deep, base 0.02 mm. from top of lips. Elements of leaf crown arising from base of capsule; sharply pointed, with tips incurved. Oesophagus 0.75 mm. long (in male), wider at base but without definite bulb. Nerve ring at 0.35 mm., excretory pore at 0.7 mm., and cervical papillae at 0.09 mm. from anterior end.

*Male*: Bursa large; lobes not deeply divided except ventrals which are separate from one another. Ventral rays long, cleft nearly all their length; externo-lateral long; laterals cleft for three-fourths length, reaching nearly to edge of bursa; externo-dorsal as long as, and arising with, laterals. Dorsal ray bifurcating after one-third length, each branch giving off a shorter lateral ray after half length, neither reaching edge of bursa. Spicules 3.8 mm. long; 1:2.7 of body length. Genital cone small; accessory cone of two prominent processes. Gubernaculum not seen.

*Female*: Posterior end tapering gradually from region of vagina; tail 0.23 mm. long, ending in point. Vagina long, twisted; vulva 0.35 mm. in front of anus.

This species resembles *Cloacina curta* and *C. wallabiae* in the head region. In general characters it suggests the latter species but differs from it in size; form of the dorsal ray; spicule-body-length ratio; absence of definite oesophageal bulb; and less sudden tapering of the posterior end of the female.



Figs. 49-52, *Cloacina magnipapillata*. 49. head; 50. posterior end of female; 51. bursa; 52. dorsal ray.

Figs. 53-54, *C. wallabiae*. 53. head; 54. bursa.

Fig. 55, *C. thetidis*, head.

Figs. 49, 53 and 55 to same scale; figs. 51 and 52.

Figs. 56-58, *Globocephaloides thetidis*. 56. head, lateral view; 57. bursa, ventral view; 58. bursa, dorsal view.

Figs. 59-62, *Hypodontus thetidis*. 59. head, ventral view; 60. head, lateral view; 61. bursa, lateral view; 62. dorsal ray.

Figs. 58 to 62, to same scale.

Figs. 63-64, *Austrostrongylus wallabiae*. 63. head; 64. bursa.

Figs. 65-66, *Asymmetricostrongylus trichosuri*. 65. head; 66. posterior end of female.

*CLOACINA WALLABIAE*, n. sp. Figs. 53-54.

From *Macropus ualabatus*, Lower Hawkesbury district (coll. J. B. Cleland).

Only five specimens found; 4-6 mm. long; some rather coiled. Apparently only four outer lips, the laterals being absent and their position marked by a pair of small conical papillae; submedians each with long two-jointed papilla; inwardly from outer lips and from lateral papillae are six distinct rounded inner lips; inwardly from these latter, projecting beyond them, is the leaf crown of six finely-pointed triangular elements, 0.04 mm. long, arising from base of buccal capsule; latter 0.038 mm. in diameter internally, 0.01 mm. long, with walls  $4\mu$  thick. Oesophagus 0.55 mm. long, widening towards base to a more or less definite bulb; nerve ring at about mid-oesophagus; excretory pore at level of three-fourths length of oesophagus. Cervical papillae, long, threadlike, about 0.15 mm. from anterior end of worm.

*Male*: Spicules about 0.9 mm. long, 1:4 of body length, thin, with very wide striated alae. Ventral rays long, thin, cleft about half length; externo-lateral stout, tapering; laterals thinner and longer; externo-dorsal arising with laterals, shorter and divergent from them. Dorsal ray bifurcating near its origin, each branch continuing nearly to edge of bursa and giving off shorter lateral ray after about one-third of its length. Genital cone very short; accessory cone of two large projecting lobes.

*Female*: Body tapering suddenly beyond vulva, which is 0.5 mm. in front of anus; tail about 0.3 mm. long, ending in rounded point; vagina long, narrow; eggs 0.08 by 0.04 mm.

This species most closely resembles *C. robertsi* in the general appearance of the head but differs in the spicule-body-length ratio; shape of the dorsal ray; length of vagina; and in the position of the excretory pore; as well as in the rather different configuration of the head region.

*CLOACINA THETIDIS*, n. sp. Fig. 55.

From *Macropus thetidis*, New England.

Only one female found, 6.5 mm. long. Lips not distinct; four submedian papillae arising from elevations of mouth collar, each papilla consisting of two thin joints; leaf crown arising from base of buccal capsule giving appearance of six rounded inner lips, on two of which the inner edge can be seen projecting as a pointed tip like the leaf crown elements in other species of *Cloacina*; similar pointed tips presumed to be present on other lips though not seen. Buccal capsule 0.055 mm. diameter, of uneven height (0.008 mm.-0.01 mm.), base 0.034 mm. from anterior end. Oesophagus 0.6 mm. long, wide, straight. Nerve ring at 0.26 mm., and cervical papillae at 0.09 mm., from anterior end.

Posterior end of body tapering to a dorsally-directed point; tail 0.2 mm. long. Vulva, 0.35 mm. from tip of tail. Specimen is probably young, eggs being present only in uterus, where they measure 0.11 by 0.08 mm.

This species differs from all known species in the wide shallow buccal capsule, the long thin papillae at the anterior end, and the rounded ends of the elements of the leaf crown.

*CLOACINA SIMILIS* Johnston & Mawson, 1939.

Females from stomach of *Macropus thetidis*, New England.

These nematodes very closely resemble *C. similis* and *C. petrogale* but, since males are absent, it is difficult to place them exactly. The head differs from that in these species in having a relatively wider buccal capsule, thinner papillae, and less obvious lips. The distinct leaf crown, the presence of a lateral papilla, the



deep buccal capsule and the long, thin anteriorly-placed cervical papilla suggest both these species. The posterior end has the characteristic short conical tail, long vagina with rather small eggs, and anus equidistant from the vulva and the tip of the tail. The positions of nerve ring and excretory pore agree most closely with those in *C. similis*, but the oesophagus differs slightly in shape, the terminal bulb being more distinct and larger.

The parasites may be placed provisionally under *C. similis*.

*CLOACINA BANCROFTORUM* Johnston & Mawson 1939.

This species was recognized amongst material from *Macropus thetidis* from New England.

*CLOACINA LONGISPICULATA* Johnston & Mawson 1939.

We have identified the species from *Macropus rufus* from Wentworth, South-western New South Wales (coll. W. L. Rait).

*CLOACINA MACROPODIS* Johnston & Mawson 1938.

From *Macropus ualabatus*, Lower Hawkesbury district (coll. J. B. Cleland).

Our specimens differ a little from those from Central Australia, the oesophagus being somewhat longer and spicules slightly shorter. The general features and arrangement of parts, however, are similar in both and there does not appear to be sufficient justification for the erection of a new species.

*CLOACINA* sp.

Two poorly preserved female specimens of *Cloacina* were found in the stomach of *Macropus thetidis*, New England. Their condition has not permitted us to make a definite identification.

*GLOBOCEPHALOIDES* Yorke & Maplestone 1926.

The genus was based on female specimens described as *G. macropodis*, from a Northern Queensland *Macropus* sp. Recently (1939) we added two other species, *G. wallabiae* and *G. affinis*, also from Queensland, and have been able to extend the diagnosis on account of the finding of males. We now add another species, *G. thetidis*.

*GLOBOCEPHALOIDES THETIDIS*, n. sp. Figs. 56-58.

From the intestine of *Macropus thetidis*, New England.

Male 6 mm.; female unknown. Buccal capsule 60 $\mu$  long, 50 $\mu$  maximum width, 20 $\mu$  wide at base; dorsal tooth projecting 20 $\mu$  from base of capsule. Mouth opening 25 $\mu$  diameter. Oesophagus 0.58 mm., 1:10 of body length. Nerve ring and excretory pore not seen. Spicules 0.045 mm., 1:13.3 of body length. Bursa with ventral lobes separated in front, ventral and lateral lobes continuous, dorsal lobe small and elongate. Ventral rays long, thin, separate, reaching edge of bursa; externo-lateral stouter, slightly shorter than ventrals; medio-lateral stout, distal part narrowing suddenly; postero-lateral slightly thinner than medio-lateral, narrowing as in latter ray; medio- and postero-lateral not quite reaching bursal edge; externo-dorsal thin, shorter than postero- and medio-laterals, raising edge of bursa into papilla-like structure. Dorsal ray ending in two short, probably bidigitate, processes.

The species differs from *G. macropodis* (female) in the size of the buccal capsule, relative size of the dorsal tooth, and length of oesophagus; from *G. affinis* (female) in the form of the chitinous support for the buccal capsule, and in the relative size of the tooth; from *G. wallabiae* (male) in size, relative length of the spicules, length of ventral rays, and form of the medio- and postero-lateral rays.

## HYPODONTUS Mönnig 1929.

This genus, belonging to the Ancylostomatidae, Necatorinae, is so far known only from its type species, *H. macropi* Mönnig, whose name should be emended to *H. macropodis*. The host was *Macropus rufus* from Pretoria Zoological Gardens. We add a second species, *H. thetidis*.

## HYPODONTUS THETIDIS, n. sp. Figs. 59-62.

From the caecum of *Macropus thetidis*, New England.

Male about 11 mm. long; female about 14 mm. Mouth collar with six very small papillae; buccal capsule with two dorsal cutting plates anteriorly, ventral margin notched. Dorsal gutter in buccal capsule, ending anteriorly in two short lateral arms, narrowing posteriorly. Anterior end of oesophagus with three pointed triangular teeth about 30 $\mu$  long, projecting into buccal capsule. Cervical glands extending back about 0.5 mm. from anterior end. Oesophagus 1.05-1.1 mm. long, 1:10-11 of body length (in male). Nerve ring at 0.6 mm. from anterior end. Cervical papillae and excretory pore not seen.

*Male*: Dorsal lobe of bursa longest; ventrals not joined in front. Ventral rays short, together; externo-lateral short, tip diverging from laterals; laterals cleft at tips, not quite reaching edge of bursa; externo-dorsal arising separately, tapering, not reaching edge of bursa. Dorsal ray bifurcating soon after origin, each branch giving off a shorter lateral ray just after its mid-length, neither branch quite reaching edge of bursa. Prebursal papillae not seen. Spicules 0.87 mm., i.e. 1:12.6 of body length. Gubernaculum large, elongate.

*Female*: Vulva 0.3 mm., and anus at 0.1 mm. from tip of conical tail.

The species closely resembles *H. macropodis* whose males are 13-15 mm., and females 17-20 mm. long. The relative measurements agree closely; the chief differences between the two are the shorter gubernaculum, greater distance between the vulva and the tip of the tail, and the lower position of the bifurcation of the dorsal ray.

## AUSTROSTRONGYLUS Chandler 1924.

This genus of Trichostrongylinae was based on *A. macropodis* Chandler from *Macropus bennetti* from Zoological Gardens, Houston, Texas. We added (1938) *A. minutus* from *M. dorsalis* in Queensland. We now give an account of another, *A. wallabiae* n. sp.

## AUSTROSTRONGYLUS WALLABIAE, n. sp. Figs. 63-64.

From the intestine of *Macropus ruficollis*, Bathurst district.

Worms very tightly coiled; tapering markedly at anterior end; cuticle with 6-8 longitudinal folds, marked with transversal striations, the cuticle between the folds being unstriated. The folds begin just posterior to the dilated cuticle around the head (0.08 mm. from anterior end) and extend in the female to the region just anterior to vulva; in the male to within a short distance of bursa where they give place to ringed striations; in the female there is little trace of striation between the vulva and anus, but on the tail fine rings are definite.

The worms are characterized by regularly-placed masses of granular tissue, forming a projection over the vulva, another a little anterior to the vulva, and one in the dorsal lobe of the bursa where it obscures the dorsal ray.

There are probably four small papillae at the anterior end, in submedian positions. Buccal capsule dome-shaped, 0.032 mm. diameter at base, 0.022 mm. long at centre, its thin chitinous walls with outwardly projecting ridge at their base; walls continuous inwardly with floor of buccal capsule and cuticular lining

of oesophagus; dorsal tooth 0.02 mm. long, 0.01 mm. wide near base; ventral tooth about  $4\mu$  long. Oesophagus about 0.38 mm. long, widening slightly towards base. Nerve cord at 0.2 mm., and excretory pore at 0.28 mm. from anterior end of worm.

*Male*: About 5.3–5.5 mm. long, 0.2 mm. maximum diameter. Spicules very fine, proximal terminations hard to observe; probably between 0.4 and 0.8 mm. long. Gubernaculum not seen. Bursa distinctive in having a very short dorsal lobe and the two lateral lobes extended laterally, so that in their natural position (i.e. before flattening) they fold together, the bursa then having the appearance of a ventral outgrowth of the posterior end of the body. Lobes not asymmetrical. Ventro-ventral ray bending ventrally; postero-ventral almost straight; externo- and medio-laterals stout, tapering, with distal ends divergent from one another; postero-lateral thin, long; externo-dorsal long, thin, arising from same base as laterals but immediately separating from them. Dorsal ray short, thin, giving off a lateral branch at each side soon after its origin, the main stem dividing into two short branches at distal end; the lateral branches may be asymmetrical.

*Female*: About 6.9 mm. long; body narrowing suddenly about 0.1 mm. from posterior end to a tapering, pointed tail. Position of vulva (1.15 mm. from posterior end) marked by presence of a projecting mass of granular tissue just beneath its cuticle, probably a kind of protective flap, somewhat like that occurring in *Haemonchus*. Vagina short; ovejectors muscular; uteri divergent but hard to trace as specimens do not clear easily. Anus probably at beginning of narrow tail, about 0.08–0.09 mm. from posterior end.

The species closely resembles *A. macropodis* (from *Macropus bennetti*, which is the Tasmanian subspecies of *M. ruficollis*), but differs from it in the different form of the bursa, dorsal ray, length of postero-lateral ray and greater divergence of the externo- and medio-lateral rays. The characters of the head region, buccal cavity and cuticular ornamentation are similar.

The species differs from *A. minutus* in its greater size, wider bursa, form of the lateral rays, and relatively shorter dorsal tooth.

#### ASYMMETRICOSTRONGYLUS Nagaty 1932.

The name was proposed by Nagaty for *Trichostrongylus asymmetricus* Cameron 1926 (as type), *T. australis* Wood 1930, and *T. dissimilis* Wood 1930, but no diagnosis was given. The first was described from *Macropus bennetti* and the other two from *M. woodwardi*, Wood also recording *A. asymmetricus* from the latter marsupial. Lent and Freitas (1934, 252) consider the genus invalid.

#### ASYMMETRICOSTRONGYLUS TRICHOSURI, n. sp. Figs. 65–66.

From the oesophagus of *Trichosurus caninus*, Gosford district.

Only females were collected. Very thin filiform worms, about 4.5 to 5.1 mm. long, with maximum breadth about  $50\mu$ . Cuticle with fine longitudinal striations and with more widely separated transverse markings. Anterior end about  $17\mu$  in diameter, apparently surmounted by six lips. Oesophagus 0.86 mm. long, of even diameter. Vulva a narrow transverse slit, 1.68 mm. from posterior end of oesophagus and at about mid-length of worm; uteri divergent; eggs large,  $60\mu$  long,  $27\mu$  wide. Posterior end tapering, narrowing suddenly from anus to end in blunt point; tail 0.06 mm. long.

The absence of males prevents our comparing the species with those described from Australian marsupials. The type, *A. asymmetricus* (Cameron), is described as having six papillae and no buccal tooth. If these papillae resemble the structures

which we refer to as lips, then our species could be placed under Nagaty's genus, as we have done.

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